REMARKS

This AMENDMENT UNDER 37 CFR 1.111 is filed in reply to the outstanding Office Action of March 24, 2000, and is believed to be fully responsive thereto for reasons set forth below in greater detail.

Initially, a review of the specification has indicated that the specification appears to have suffered from a translation from Japanese into English, and contains a large number of grammatical and other errors. In view thereof, a substitute specification is submitted herewith pursuant to 37 CFR 1.125(b), along with a marked up version of the substitute specification.

The undersigned attorney states that the substitute specification includes no new matter.

Moreover, a proposed correction to Figure 4 is attached hereto to conform Figure 4 to the detailed written description.

Responsive to paragraphs 1-4 of the Official Action, the terminology throughout the specification is now conformed to the following:

(1) an amount of power generation, which is the power generated by a power generator;

(2) an amount of power storage, which is the power flowing into the power storage;

(3) an amount of remaining power capacity, which is the amount of power remaining stored in the power storage.

In the present invention, the term "power storage amount" means, as shown by amended Fig. 4, the amount of power that flowed into a power storage means 2 from a power generation means 1, and it is detected by a power storage amount detecting means 31.

Therefore, the power storage amount detecting means 31 may have a function similar to a current detecting means such as an ammeter or the like.

Accordingly, the power storage amount is completely different from the "amount of remaining capacity."

In the several embodiments of the present invention, (1) an amount of power generation of a power generation means, (2) an amount of power storage which is the power flowed into a power storage means, and (3) an amount of remaining capacity of the power storage means, are used for controlling the operation of a rechargeable electronic watch, singularly or in combination.

However, in the original specification, the term "power storage amount" and the term "the remaining capacity amount" were confusing used relative to each other so as to cause confusion and a possible misunderstanding of the present invention.

Therefore, the applicant has amended the specification and claims changing "charge amount: to --power storage amount--, so as to clarify the present invention. Accordingly, the term "charge amount" is no longer used in the present specification and claims.

Support for the power storage amount is found in the original specification at page 22, third and fourth lines from the end, which refer to "a power storage amount detecting means for detecting the power storage amount to the accumulation means."

Support for the amendments to Figure 4 are found in the original written description of Figure 4, particularly at the top of page 18.

The improper multiple dependencies have been obviated by amendments to claims 42 and 45 to eliminate an improper dependency upon claim 33.

Reconsideration is respectfully requested of the rejections of the claims herein over the prior art, particularly in view of the clarifying amendments to claims 29, 31, 32, 37, 39, 40, 47 and 49, the cancellation of claims 27, 28 and 30, and the following comments on the distinctions of the present invention and claims over the prior art.

Reconsideration is respectfully requested of the rejection of claims 29 and 47 under 35 USC 102(e) as being anticipated by USP'304, as the applicant feels that USP'304 fails to show or suggest the technical concept that an amount of power storage (as explained and defined above and in the claim) is used for controlling an operation of an electronic watch.

Reconsideration is respectfully requested of the rejection of claim 32 under 35 USC 102(e) as being anticipated by USP'304, as the applicant feels that USP'304 fails to show or suggest the technical concept that an amount of power generation of a power generation means and an amount of power storage in a power storage means are used for controlling an operation of an electronic watch.

Reconsideration is respectfully requested of the rejection of claims 33 to 35 under 35 USC 102(e) as being anticipated by USP'304, as the applicant feels that USP'304 does not disclose the technical feature of these claims that depending upon a detected condition of any one of (1) an amount of a power generation of a power generation means, (2) an amount of power storage stored in a power storage means and (3) an amount of remaining capacity of the power storage means, the most pertinent time keeping operation which has a power consumption suitable for the detected level of the condition, is selected from a plurality of the time keeping operations.

Reconsideration is respectfully requested of the rejection of claims 32, 46 and 48 under 35 USC 102(e) as being anticipated by USP'304, as the applicant feels that USP'304 does

not disclose the technical feature of these claims that depending upon a detected condition of (1) an amount of a power generation of a power generation means, (2) an amount of remaining capacity of the power storage means or (3) an amount of power generation of a power generation means and an amount of power storage in a owner storage means, the most pertinent time keeping operation which has a power consumption suitable for the detected level of the condition, is selected from a plurality of the time keeping operations.

Reconsideration is respectfully requested of the rejection of claim 36 under 35 USC 103(a) as being obvious to a person skilled in this art from USP'953, as the applicant feels that USP'953 does not disclose the technical feature of this claim that depending upon a detected amount of a power generation of a power generation means and an energy balance of the detected amount of the power generation and a predetermined amount of power consumption of the rechargeable electronic watch, the most suitable clock operation mode is selected among a plurality of clock operation modes each having respective power consumption of the rechargeable electronic watch which are different from each other.

Reconsideration is respectfully requested of the rejection of claim 37 under 35 USC 102(a) as being anticipated by USP'953, as the applicant feels that USP'953 does not disclose the technical feature of this claim that depending upon a detected amount of a power storage amount of a power storage means and an energy balance of the detected amount of the power storage amount and a predetermined amount of power consumption of the rechargeable electronic watch, the most suitable clock operation mode having a pertinent power consumption, is selected from among a plurality of clock operation modes each having respective power consumption of the rechargeable electronic watch which is different from each other.

This application is now believed to be in condition for allowance, and a Notice of

Allowance is respectfully requested. If the Examiner believes a telephone conference might expedite prosecution of this case, it is respectfully requested that he call applicant's attorney at (516) 742-4343.

Respectfully submitted,

William C. Roch
Registration No. 24,972

SCULLY, SCOTT, MURPHY & PRESSER
400 Garden City Plaza
Garden City, New York 11530
(516) 742-4343

WCR/jf

RECHARGEABLE ELECTRONIC WATCH AND DRIVING METHOD OF RECHARGEABLE ELECTRONIC WATCH

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention is related to a rechargeable electronic watch and a driving method of the rechargeable electronic watch, and more particularly, a rechargeable electronic watch of which the clock operation duration can be prolonged and a driving method of the same.

2. Description of the Related Art

Conventionally, some electronic watches are provided with an additional power saving mode function for reducing the power consumption of the electronic watch provided that it would not hinder particularly the use of the electronic watch, for the purpose of using as long as possible the power supply means composed of ~~battery or~~ a storage battery or the like used at the same time as a power generation means.

For instance, as disclosed in the Japanese Unexamined Patent Publication (KOKAI) No.5-60075, an electronic watch using a solar cell as a main ~~battery composed to~~power source enters the power save mode when there is no sunlight incident ~~to~~on the solar cell of the electronic watch continuously for a predetermined fixed time~~continuously~~, and ~~to release~~exits the power saving mode when there ~~will be~~ is sunlight incident ~~to~~ on the solar cell again~~is known~~.

~~By the way~~Also, the power saving mode function in such a conventional electronic

watch is ~~composed~~ designed to enter the power saving mode for stopping all hour display and stop driving of the display means including hour information display in a state disadvantageous for the power source, for instance, when a solar cell is used as a power source, because it is ~~primordial~~ essential to use the power source as long as possible.

However, in recent years, an analog electronic watch whose ~~time~~ hour and minute hands and second hand are driven by separate motors for ~~hour~~ time display, or a combination electronic watch wherein the seconds ~~is~~ are displayed by a liquid crystal display are also made for practical use, and if all hour display is stopped under a certain condition, the user could not obtain any information at all.

On the other hand, electronic watches provided with a built-in display mechanism of several kinds of functions including a chronometer display function, alarm display function, atmospheric pressure display function, water depth display function or the like are also made for practical use, and are ~~composed~~ designed to display on a predetermined display means the kind or kinds of function information at the same time as the hour information, or changing over with the hour information.

In such ~~resent~~ recent electronic watches implementing function information other than hour information, if a conventional type power saving mode function is used, not only the hour information but also function information are not displayed at the same time on the display means, when a state disadvantageous for the power source as mentioned above happens, blocking the use of the function information display means, particularly in an environment requiring function information, causing to reduce the product value as a multi-functional electronic watch.

On the other hand, ~~the~~ Japanese Unexamined Patent Publication (KOKAI) No. 9-304555 discloses a rechargeable electronic watch wherein a counter is installed for measuring the ~~lap~~ elapsed time after the motor stops, to facilitate ~~to~~ a return to an accurate actual hour even when the hand motion is stopped for power saving, and for measuring rapid advance time also, to return ~~time~~ hour and minute hands to the accurate actual time from both measured times.

However, in the Publication, the motion of the ~~time~~ hour and minute hands stops only when the output from the power generation means or power storage means of the rechargeable electronic watch becomes equal or ~~inferior to~~ below a predetermined level, namely, only under a certain fixed condition; therefore, in a rechargeable electronic watch provided with a plurality of additional functions, the additional functions become completely unavailable, event when the voltage state allows ~~to~~ the ~~used~~ of the additional functions, causing the user inconvenience.

SUMMARY OF THE INVENTION

Therefore, ~~the~~ an object of the present invention is to improve the aforementioned defects of the prior art and to provide an electronic watch in that in displaying clock information and function information on separated display means, respectively, for example, by hands and by a liquid crystal display, the electronic watch can be selectively controlled under the most optimal clock operation mode selected from a plurality of clock operation modes by selecting an arbitrary circuit or by using a display means whereby the display means can be stopped, in response to an amount of power generation in a power generator or an amount of power storage flowing into ~~charge~~

~~stored in~~ a power storing means, ~~as~~ in a power saving mode.

A ~~Further~~ further object of the present invention is to provide a rechargeable electronic watch among multi-functional rechargeable electronic watches providing a number of additional function information, which ~~cannot~~ does not loose complete usage ~~feeling~~ of the rechargeable electronic watch by forming the electronic watch so that one of the functions of the rechargeable electronic watch can be selected arbitrarily in response to either an amount of power generation in a power generator or an amount of power storage flowing into ~~charge stored in~~ a power storing means so as to optimize a balance of the power, which is the same as that in an electronic watch only displaying time information, whereby it is intended to extend a clock operation duration of the rechargeable electronic watch as well as to keep limitations for using a certain function a user of the watch wishes to use at the ~~most necessary~~ lowest level.

In order to attain the above-mentioned objects of the present invention, the present invention basically has the technical construction as mentioned hereunder.

Note that, a first aspect of the present invention is a rechargeable electronic watch operating with an energy source comprising a power supply including a power generation means and a power storage means charged with electric energy generated from the power generation means, the rechargeable electronic watch comprising a watch circuit for counting or processing time information or function information or the like so as to output~~ting~~ the information, a display means for displaying the time information or the function information or the like based on an output signal from the watch circuit, a power generation amount detecting means for detecting ~~an~~ the amount of ~~the~~ power generation of the power generation means, and a control means for controlling the

operation of the watch circuit in response to the amount of the power generation , wherein the watch circuit is driven in at least one clock operation mode selected, based on the control of the control means, from a plurality of clock operation modes provided in the rechargeable electronic watch, with each of the modes being different from each other in power consumption.

A second aspect of the present invention is a rechargeable electronic watch operating with an energy source comprising a power supply including a power generation means and a power storage means charged with electric energy generated from the power generation means, the rechargeable electronic watch comprising a watch circuit for counting or processing time information or function information or the like so as to output~~ting~~ the information, a display means for displaying the time information or the function information or the like based on an output signal from the watch circuit, a power storage ~~charge~~ amount detecting means for detecting ~~an~~ the amount of power storage flowing into ~~charge stored~~ in the power storage means, and a control means for controlling the operation of the watch circuit in response to the amount of the power storage ~~charge~~, wherein the watch circuit is driven in at least one clock operation mode selected, based on the control of the control means, from a plurality of clock operation modes provided in the rechargeable electronic watch, with each of the modes being different from each other in power consumption.

A third aspect of the present invention is a rechargeable electronic watch operating with an energy source comprising a power supply including a power generation means and a power storage means charged with electric energy generated from the power generation means, there chargeable electronic watch comprising a watch circuit for

counting or processing time information or function information or the like so as to output~~ting~~ the information, a display means for displaying the time information or the function information or the like based on an output signal from the watch circuit, a power generation amount detecting means for detecting ~~an~~ the amount of ~~the~~ power generation of the power generation means, a power storage ~~charge~~ amount detecting means for detecting ~~an~~ the amount of power storage flowing into ~~charge stored in~~ the power storage means, a remaining capacity detecting means for detecting the remaining capacity of the power storage means and a control means for controlling the operation of the watch circuit in response to the ~~optional~~ two optional detected values selected among three detected values, such as the power generation amount, the power storage ~~charge~~ amount and the remaining capacity, wherein the watch circuit is driven in at least one clock operation mode selected, based on the control of the control means, from a plurality of clock operation modes provided in the rechargeable electronic watch, with each of the modes being different from each other in power consumption.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram showing the composition of one ~~concrete example~~exemplary embodiment of the rechargeable electronic watch of the present invention;

Fig. 2 is a block diagram showing the composition of a first exemplary embodiment ~~concrete example~~ of there chargeable electronic watch of the present invention;

Fig. 3 is a block diagram showing the composition of a second exemplary

embodiment ~~concrete example~~ of the rechargeable electronic watch of the present invention;

Fig. 4 is a block diagram showing the composition of a fourth exemplary embodiment ~~concrete example~~ of the rechargeable electronic watch of the present invention; and

Fig. 5 is a block diagram showing the composition of a fifth exemplary embodiment ~~concrete example~~ of there chargeable electronic watch of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Now, specific examples of rechargeable electronic watches and driving methods of rechargeable electronic watches of the present invention will be described in detail referring to drawings.

Namely, Fig. 1 is a block diagram illustrating the composition of one exemplary embodiment ~~concrete example~~ of a rechargeable electronic watch 10 according to the present invention, and in the drawing, a rechargeable electronic watch 10 operating with an energy source comprising a power supply 26 including a power generation means1 and a power storage means 2 charged with electric energy from the power generation means 1, the rechargeable electronic watch 10 comprising a watch circuit 5for counting or processing time information or function information or the like and outputting information, a display means 11 for displaying time information or function information or the like based on output signal from the watch circuit, an amount of power generation detecting means 3 for detecting the power generation amount of the power generation

means 1, and a control means 4 for controlling the operation of the watch circuit 5 in response to the power generation amount, wherein said watch circuit 5 is driven in at least one clock operation mode selected, based on the control of said control means, from a plurality of clock operation modes provided in said rechargeable electronic watch, with each of the modes being different from each other in power consumption.

In other words, Fig. 1 is a block diagram ~~showing the outline composition of~~ essential parts of ~~the~~ one rechargeable electronic watch 10 according to the present invention, and the power generation means 1 composing the power supply 26is not particularly limited in its composition, but it may be a solar cell, self-winding type power generator for generating power in response to the motion, including arm motion, thermal power generator for generating power using differential temperature, or those using spring drive power generation or the like.

In addition, the power storage means 2 in the present invention is not particularly limited in its composition; however, for instance, a rechargeable secondary battery can be employed.

On the other hand, besides the means 30 for detecting the amount of ~~the~~ power generation of the power generation means, the power generation amount detecting means 3 may ~~be composed to~~ include a power storage amount detecting means 31 for detecting the power storage amount (power flowing into)~~to of~~ the ~~accumulation~~ power storage means 2.

The power generation amount detecting means 3 of the present invention can ~~be realized by composing to~~ detect, for instance, voltage or current output from the power generation means 1 or the power storage means 2, ~~even in case of~~ in addition to

detecting an amount of the power generation, or ~~in case of~~ detecting an amount of the power storage.

Next, the control means used in the present invention has a function to select a clock operation mode which ~~being~~ is the most appropriate for the concerned object, ~~with taking~~ while considering the conditions of the power generation amount of the power generation means 1 detected by the ~~aforementioned~~ power generation amount detecting means 3 or the ~~amount of the~~ remaining capacity stored in the power storage means 2, ~~into the account, a p~~Processing is performed by determining whether or not the degree of the power generation amount of the power generation means 1 or the remaining capacity stored in the power storage means 2 at the current period, is at a sufficient level for operating all of the plurality of the ~~clock~~ watch operation modes provided on the electronic watch circuit 5, or by determining which clock operation mode would ~~be~~ preferably ~~to~~ be selected or which clock operation mode would be preferably ~~to~~ be stopped while taking the power consumption of each one of the clock operation modes into ~~the~~ account so as to keep the remaining capacity of the power storage means for ~~a~~ as long a time as possible ~~it can~~.

The control means 4 has a data master or lookup table 70 for memorizing individually the power consumption amount in each of the aforementioned several kinds of clock operation modes, and selects and controls the optimal state from several kinds of clock operation modes based on the information from the lookup table 70 and the power generation amount detecting means 3.

On the other hand, the watch circuit 5 ~~used in the present invention is composed to operate supplied with power from the power supply 26, and~~ includes a time circuit 6 for

outputting hour information and a clock operation mode setting means 40 for executing the various clock operation modes.

The clock operation mode setting means 40 of the present invention ~~includes~~ preferably includes at least one of driving operation modes such as, for example, a second hand driving operation mode for driving the second hand, ~~namely~~ with a second hand driving operation mode setting means 7, a minute and hour hands driving operation mode for driving the minute and hour hands, ~~namely~~ with a minute and hour hands driving operation mode setting means 8, a liquid crystal display means driving operation mode setting means 9, and further, an alarm function driving operation mode setting means 12, a chronometric function driving operation mode setting means 13, a water depth measuring function driving operation mode setting means 14, a temperature measuring function driving operation mode setting means 15, an altitude measuring function driving operation mode setting means 16, an atmospheric pressure measuring function driving operation mode setting means 17, a radio reception function driving operation mode setting means 18, and a calendar display function driving operation mode setting means 19 ~~or the like~~.

For the aforementioned respective clock operation modes, the power consumption required for executing ~~its~~ each driving operation mode ~~respectively each other,~~ is sometimes identical, but is generally different ~~in general~~; therefore, electric energy consumption in the power supply 26 ~~becomes~~ is different~~, by~~depending upon which and how many of the several kinds of clock operation modes~~, namely clock operation modes~~ are ~~to be~~ selected.

Consequently, when the power generation amount, or the remaining capacity in the

power supply 26 is sufficient, all of the respective clock operations modes ~~installed~~ of the rechargeable electronic watch 10 ~~mentioned above~~ may ~~well~~ be driven; however, when the power generation amount, or the remaining capacity in the power supply 26 is low, ~~it is composed to execute~~ the ~~selection~~ operation is selected to drive only the minimum required clock operation modes based on the power generation amount or the remaining capacity of the power generation means at thate actual point of time so as not to ~~deteriorate~~detract from the usefulness ~~feeling of use of the user~~ of the rechargeable electronic watch 10 provided with additional functions, by maintaining the remaining capacity in the power supply 26.

As the power consumption ~~during the driving in the aforementioned~~in each respective driving operation mode can be predetermined, it is preferable to ~~composed~~ to store that information in a convenient data base, or in memory ~~memorize~~ in a predetermined format lookup table, and allow the control means 4 to refer to the data base or lookup table.

The display means 11 of the present invention may be ~~composed of~~ any of a digital display ~~mechanism~~ or an analog display ~~mechanism~~, and for instance, if the display means 11 is selected as an ~~adopts the~~ analog display system, a second hand display 20 ~~as second display apparatus~~ and an hour and a minute hand display 21 ~~as hour and minute display apparatus~~ are provided, and at the same time, the second hand driving operation mode setting means 7 and the hour and minute hand driving operation mode setting means 8 are connected to a second hand motor driving circuit 50 and a hour and minute motor driving circuit 51 respectively.

Besides, in the display means 11 of the present invention, if both the second display

~~apparatus~~ 20 and the hour and minute display ~~apparatus~~ 21 ~~adopt~~select a digital display data composed of a digital circuit, ~~the~~ both ~~apparatuses result in~~ us~~inge~~ a crystal liquid display means, and in this case, the second hand motor driving circuit 50 and the hour and minute motor driving circuit 51 ~~become~~are unnecessary.

In addition, if a calendar function is to be used, or ~~the~~ other measurement results are to be displayed, they can be displayed by the ~~crystal~~ liquid crystal display ~~means~~ 22, and in this case, the liquid crystal display ~~means~~ 22 is preferably driven ~~through~~ by a convenient liquid crystal liquid driving control circuit 52.

Similarly, in the present invention, if an alarm function or chronometric function are adopted, a digital display ~~apparatus~~ is preferably used as the display means corresponding to the respective function, and an analog display ~~apparatus~~ may also be used.

As for the display means when the alarm function is to be executed, sound, or light, vibration or other reporting means can be adopted, and sound report means 23, optical report means 24 or vibration report means 25 or the like forth is effect can be installed in the display means 11.

~~In t~~The rechargeable electronic watch 10 of the present invention~~, it~~ may also be composed to receive radio electric waves containing hour information, and in this case, it ~~is~~ operates to make the time circuit agree with the hour information of the received electric waves, by driving a reception circuit provided in the rechargeable electronic watch 10, at a predetermined timing, and ~~it goes without saying that~~ the power consumption at that time is also controlled by the present invention.

In such case, it is not necessary ~~useless~~ to provide especially the display means 11

with a specific display circuit; however, the reception state of the radio signal containing hour information may be displayed by an optical display means 24 or the like.

Now the operation algorithm of the control means 4 used in the present invention will be described.

Note that, the ~~control~~ object of the control means 4 in the present invention is to select a clock operation mode for achieving the required power saving operation mode, by~~with~~ determining an amount of the power generation of the power generating means 1 or the remaining capacity of the power storage means 2, both of which ~~consisting~~constitute the power supply 26 of there chargeable electronic watch 10 and by processing to realize how the power supply 26 can be ~~kept in~~maintained effective for a long time, or to realize a power saving mode by considering which kind of clock operation mode, among a plurality of clock operation modes, provided in the rechargeable electronic watch 10, should be selected so as to reduce the power consumption of the rechargeable electronic watch 10, in order to display the necessary function information even when the amount of the power generation or the amount of the remaining capacity of the power supply 26 has been reduced.

For instance, the control means 4 detects automatically the condition in which the remaining capacity of the power storage means 2 has become equal to or lower than ~~the~~ a predetermined threshold value, or the amount of ~~the~~ power generation of the ~~the~~ power generation means 1 in the power supply 26 has become equal to or lower than ~~the~~ a predetermined threshold value, or ~~an~~ the amount of ~~the~~ sunlight incident ~~to~~ on the solar power generator is equal to or lower than ~~the~~ a predetermined threshold value

continuously for a predetermined period of time, when the power generation means 1 is a solar power generator, and performs ~~the~~ operation processing to select a clock operation mode ~~allowing~~ to obtain the most appropriate power saving state in terms of power consumption, among the several kinds of clock operations states of the rechargeable electronic watch 10.

Consequently, if the power generation amount of the power generation means 1 in the power supply 26 is sufficient, or the remaining capacity of the power storage means 2 in the power supply 26 is sufficient, all clock operation modes ~~loaded previously~~provided on the rechargeable electronic watch 10 can be driven, ~~and such a state~~which is one of the clock operation modes of the present invention.

~~Besides, i~~If the power generation amount of the power generation means 1or the remaining capacity of the power storage means 2 in the power supply 26 has become slightly lower than ~~that the~~a predetermined threshold, it is possible ~~to execute such a control~~ to set several kinds of clock operation modes ~~under~~ in which a driving operation is stopped of at least one clock operation mode having a low power consumption, selected from all of the clock operation modes ~~loaded previously~~provided on the rechargeable electronic watch 10. ~~is stopped or on the contrary, i~~It is also possible to ~~control so as to~~ stop driving operation of at least one clock operation mode having large power consumption, among all of the clock operation modes ~~loaded previously~~provided on the rechargeable electronic watch 10.

Similarly, if the power generation amount of the power generation means1 or the remaining capacity of the power storage means 2 in the power supply 26has become considerably lower that ~~the~~ a predetermined threshold, ~~for example,~~ it is possible to

~~execute such a control to~~ set several kinds of clock operation modes, to stop a plurality of driving operations among a plurality of driving operations different in their power consumption, among all clock operation modes ~~loaded previously~~provided on the rechargeable electronic watch 10.

Further, in the present invention, it is also possible to ~~execute such a control to~~ set a clock operation mode ~~allowing a condition under~~in which the power supply 26 can be used as long as possible, or ~~allowing a condition under~~in which a predetermined necessary function can be driven regardless of the current situation of the power generation amount of the power generating means 1 or of the remaining capacity of the power storage means 2, by detecting ~~how extent~~ the amount of the power generation of the power generating means 1 or the amount of remaining capacity of the power storage means 2, both ~~of which consisting~~constituting the power supply 26, has been reduced from ~~the~~ a predetermined threshold ~~and~~ while taking into account the present ~~situation of the~~ amount of the power generation of the power generating means 1 or the amount of remaining capacity of the power storage means 2~~, into account~~.

The control method ~~in~~ of the present invention mentioned above may ~~be the one composed to~~ process the operation automatically, according to a predetermined program, or particularly, as for the operation concerning the additional function, it is possible to modify the clock operation mode~~,~~ so that the power saving operation mode ~~be~~ is set~~,~~ by ~~a~~the manual operation of the user.

In the present invention, even if any driving means of the display means 11 and the watch circuit 5 ~~of the rechargeable electronic watch 10~~ is in the power saving operation mode, the predetermined display information is certainly erased from the display means;

however, it is ~~composed to~~ allows the hour information in the rechargeable electronic watch 10 to display the actual hour immediately~~, when~~after the power saving operation mode is cancelled, as the time circuit 6 ~~runs always normally~~operates constantly, and its state is always ~~memorized~~stored in a ~~predetermined~~ memory.

For example, ~~at the same time as composing to~~by counting the time during which the hour display is ~~suspension~~ suspended by providing a convenient counter, the ~~resume~~ resumption of the hour display can be realized by providing a fast-forward means, to fast forward the hour and minute hands to the actual hour.

The first exemplary embodiment ~~concrete example~~ of the present invention, in the block diagram of Fig. 2,is ~~composed~~ designed to control the control means 4 according to the power generation amount of the power generation means 1 sensed by the power generation amount detecting means 30. ~~for detecting the power generation amount of the power generation means 1, and now~~Now, an exemplary embodiment ~~concrete example~~ of the driving method of the rechargeable electronic watch 10 of the present invention will be described referring to Table 1.

In ~~other words, in~~ this exemplary embodiment~~concrete example~~, the display means 11 of the rechargeable electronic watch 10 ~~is supposes to~~ comprises a second display ~~apparatus~~ 20, an hour and minute display ~~apparatus~~ 21 and a calendar display ~~apparatus~~ 22, and a second hand motor driving control circuit 50, an hour and minute motor driving control circuit 51, and a calendar display apparatus driving control circuit 52 or the like are disposed between the watch circuit 5 and the display means 11.

Also, it is supposed that, in the display means 11, the power consumption of the calendar display ~~apparatus~~ 22 is the largest, ~~then~~ the power consumption of the second

display ~~apparatus~~ 20 is second largest, and the power consumption of the hour and minute display ~~apparatus~~ 21 is lowest among the aforementioned three kinds of displays ~~apparatuses~~.

In such a situation, the display means 11 is controlled to one of several levels of clock operation modes according to ~~the case where~~whether the power generation amount of the power generation means 1 sensed by the power generation amount detecting means 3 is equal or lower than ~~the~~ a predetermined threshold value, ~~and~~ or the power generation amount is equal or ~~superior to~~above the threshold, and further the degree of the power generation amount.

In this exemplary embodiment~~concrete example, for example~~, as ~~it is obvious~~is apparent from Table 1, the second hand motor driving control circuit 50, the hour and minute motor driving control circuit 51, and the calendar display ~~apparatus~~ driving control circuit 52 are activated respectively by a control signal Ea for controlling the liquid crystal display driv~~inger~~ ~~apparatus~~ driving the calendar display means, a control signal Eb for controlling the driving of the second display ~~apparatus~~, and a control signal Ec for controlling the driving of the hour and minute second display ~~apparatus output~~ according to the sensed power generation amount from the power generation amount detecting means 3.

In the Table 1, the control signal H indicates ~~the~~ an active state.

In other words, if the power generation amount of the power generation means 1 is equal to or lower than ~~the~~ a predetermined threshold value, all control signals Ea, Eb, Ec are set to "L" level to stop the display operation of the aforementioned three kinds of displays ~~apparatuses~~.

Even in such state, the time circuit 6 of the watch circuit 5 is driven normally.

Next, even when the power generation amount of the power generation means 1 is equal to or ~~superior to~~above the predetermined threshold value, if its power generation amount is low, only the hour and minute display ~~apparatus~~ 21 of which power consumption is the lowest is driven, among the aforementioned three kinds of displays ~~apparatuses~~, while the driving of the other displays ~~apparatuses~~ 20, 22 is set to stop.

On the other hand, when the power generation amount of the power generation means 1 is equal to or ~~superior to~~above the predetermined threshold value and its power generation amount is relatively high, the hour and minute display ~~apparatus~~ 21 of which power consumption is the lowest and the second display ~~apparatus~~ 20 requiring the next lowest power consumption are driven, among the aforementioned three kinds of displays ~~apparatuses~~, while the driving of the calendar display ~~apparatuses~~ 22 is set to stop.

Further, when the power generation amount of the power generation means1 is equal to or ~~superior to~~above the predetermined threshold value and its power generation amount is considerably high, it is controlled to drive all of the aforementioned three kinds of displays ~~apparatuses~~.

This exemplary embodiment ~~concrete example~~ adopts an algorithm to drive the displays ~~apparatuses~~ beginning from the one lowest in power consumption, in response to the increasing degree of the power generation amount of the power generation means 1; however, this order can be modified, and in addition, as mentioned below, it is also possible to ~~compose to~~ stop intentionally a predetermined display ~~apparatus~~ and to drive a predetermined display ~~apparatus~~ by the user setting.

Now, a second exemplary embodiment ~~concrete example~~ of a rechargeable

electronic watch and driving method ~~of rechargeable electronic watch~~ of the present invention will be described in detail referring to Fig. 3 and Table 2.

In ~~other words, in~~ this exemplary embodiment~~concrete example~~, compared to the aforementioned first example, the detecting means is provided with a power generation amount detecting means 3 for detecting the power generation amount of the power generation means 1 and a power storage amount detecting means 31 for detecting the power storage amount flowing into ~~to of~~ the ~~accumulation~~ strorage means 2 or a remaining capacity detecting means 32, and it ~~is composed to~~ determines the clock operation mode~~, namely clock operation mode,~~ based on both detecting information.

~~Namely,~~ This exemplary embodiment~~concrete example is composed to~~ selects ~~on~~an operation mode mode modifying the combination of displays ~~apparatus~~ to be operated respectively, according to the magnitude of the power generation amount and the magnitude of the remaining capacity.

~~There~~,This, exemplary embodiment ~~the composition~~ of the rechargeable electronic watch 10 ~~in this concrete example is supposed to be~~is similar to the exemplary embodiment ~~composition~~ shown in Fig. 2 except that the power storage amount detecting means 31 or the remaining capacity detecting means 32 are added, the second hand motor driving control circuit 50, the hour and minute motor driving control circuit 51 and the calendar display apparatus driving control circuit 52 are activated respectively by a control signal Ea (liquid crystal display), a control signal Eb (second display), and a control signal Ec (hour and minute second display) from a power generation amount detecting means 30; however, ~~at the same time,~~ it is controlled to select one of the clock operation modes, ~~setting~~ selectively setting the second hand

motor driving control circuit 50, the hour and minute motor driving control circuit 51, and the calendar display apparatus driving control circuit 52 to an activated state or a non-activated state respectively, as shown in Table 2, by limiting the control signal from the power generation amount detecting means 30 by ~~means of~~ a control signal Ma controlling the liquid crystal display ~~driving~~ driver ~~apparatus~~ driving the calendar display means, a control signal Mb for controlling the driving of the second display ~~apparatus~~, and a control signal Mc for controlling the driving of the hour and minute second display ~~apparatus~~, by the output from a remaining capacity detecting means 32.

In ~~other word, in~~ this exemplary embodiment~~concrete example~~, a rechargeable electronic watch 10 operating with ~~an energy source comprising~~ a power supply 26 including a power generation means 1 and a power storage means 2 charged with electric energy from the power generation means 1, the rechargeable electronic watch 10 ~~comprising~~ comprises a watch circuit 5 for counting or operating hour information or function information or the like and outputting information, a display means 11 for displaying hour information or function information or the like based on an output signal from the watch circuit 5, a power generation amount detecting means 30 for detecting the power generation amount of the power generation means 1, a remaining capacity detecting means 32 for detecting the remaining capacity of the power storage means 2, and a control means 4 for controlling the operation of the watch circuit 5 according to the remaining capacity and the power generation amount, wherein the watch circuit is driven by at least one clock operation mode selected from a plurality of clock operation modes different in power consumption. ~~provided by the watch circuit 5 based on the control of the control means 5, can be obtained.~~

In the third exemplary embodiment ~~concrete example~~ of the present invention, it is also possible to ~~compose to~~ control the control means 4, according to the power generation amount of the power generation means 1 sensed by the power generation amount detecting means 30 and the remaining capacity of the power storage means 2 sensed by the remaining capacity detecting means 31, in the block diagram of Fig. 1.

~~On the other hand,~~In the fourth exemplary embodiment ~~concrete example~~ of the present invention ~~is, as,~~ shown in Fig. 4, a rechargeable electronic watch 10 ~~operating~~ operates with ~~an energy source comprising~~ a power supply 26 including a power generation means 1 and a power storage means 2 charged with electric energy from the power generation means 1~~,~~. ~~the~~ The rechargeable electronic watch comprises~~comprising~~ a watch circuit 5 for counting or operating hour information or function information or the like and outputting information, a display means 11 for displaying hour information or function information or the like based on an output signal from the watch circuit 5, a power storage amount detecting means 31 for detecting the power storage amount into ~~of~~ the power storage means 2, a remaining capacity detecting means 32 for detecting the remaining capacity of the power storage means 2, and a control means 4 for controlling the operation of the watch circuit 5 according to the remaining capacity and the power storage ~~generation~~ amount, wherein the watch circuit is driven by at least one clock operation mode selected from a plurality of clock operation modes different in power consumption provided by the watch circuit 5 based on the control of the control means 5.

~~On the other hand, as an example of~~An exemplary control algorithm in the control means 4 in the present invention~~, for example, it~~ may ~~composed to~~ drive in a clock operation mode of low power consumption, among a plurality of clock operation modes

different in power consumption, ~~the lower is~~as the power generation amount of the power generation means 1 becomes lower, or to ~~control to~~ drive in a clock operation mode of low power consumption, among a plurality of clock operation modes different in power consumption, ~~the lower is~~as the power storage amount of the power storage means 2 becomes lower.

Moreover, in the present invention, it is also possible to ~~control to~~ drive in a clock operation mode of low power consumption, among a plurality of clock operation modes different in power consumption, ~~the lower is~~as the remaining capacity of the power storage means 2 becomes lower.

Now, a fifth exemplary embodiment ~~concrete example~~ of the rechargeable electronic watch 10 according to the present invention will be described in detail referring to Fig. 5 and Table 3.

While, ~~in~~ the aforementioned exemplary embodiments~~respective examples, it is composed to~~ select one of a plurality of clock operation modes ~~of~~ putting some or all of the respective displays ~~apparatuses~~ in the display means 11 in a driving state or putting all of the respective display apparatuses in a non driving state, according to a predetermined algorithm, based on output information from respective detecting means of power generation amount detecting means 30, power storage amount detecting means 31 or remaining capacity detecting means 32, or the like; however, in this exemplary embodiment~~concrete example~~, the rechargeable electronic watch 10 is further provided with a ~~an~~ user setting means 80 allowing the user to set the clock operation mode, and the control means 4 ~~it is composed~~ to drive the watch circuit 5 in a clock operation mode desired by the user, based on the output signal from the user setting means 80, namely, a

signal showing that the user has set consciously a predetermined power saving function.

Consequently, the block diagram of this exemplary embodiment ~~concrete example~~ is substantially similar to Fig. 3, and has a composition in which the remaining capacity detecting means 32 of Fig. 3 is ~~substituted with~~replaced by the user setting means 80.

In such composition, the second hand motor driving control circuit 50, hour and minute motor driving control circuit 51 and calendar display apparatus driving control circuit 52 are activated respectively by control signals Ea (liquid crystal display) Eb (second display) Ec (hour and minute ~~second~~ time display) from the power generation amount detecting means 30;however, the control signal from the power generation amount detecting means 30 is limited by means of control signals Sa (liquid crystal display) Sb (second display) Sc (hour and minute ~~second~~ time display) for power saving function setting selected and controlled by the operation setting of the user through the user setting means 80.

The operation signal by the user setting means 80 is, for example, set to (1) always execute all displays; (2) limit only the liquid crystal display according to the power generation amount; (3) limit the liquid crystal and second display according to the power generation amount; and (4) limit the liquid crystal, second display, and the hour and minute display according to the power generation amount.

Control signals and operation modes according to the power generation amount and the user setting are as shown Table 3.

The present invention intends, basically, to extend the use period of time of the rechargeable electronic watch as long as possible without ~~affecting the feeling of use of the user~~degrading usage, by controlling so that the energy balance of the power

generation amount in the power generation means 1 minus the energy consumption by the display means 11 ~~would~~ is not ~~be~~ negative and, for this effect, it is also necessary to control the energy balance.

In other words, in the present invention, a rechargeable electronic watch operating with an energy source comprising a power supply including a power generation means and a power storage means charged with electric energy from the power generation means, the rechargeable electronic watch comprising a watch circuit for counting or operating hour information or function information or the like and outputting information, a display means for displaying hour information or function information or the like based on output signal from the watch circuit, a power generation amount detecting means for detecting the power generation amount of the power generation means, and a control means for controlling the operation of the watch circuit according to the energy balance of the power generation amount and the clock power consumption amount, wherein the watch circuit is driven ~~by~~ in at least one clock operation mode selected from a plurality of clock operation modes different in power consumption provided by the watch circuit based on the control of the control means ~~is also one of concrete examples~~.

~~Here,~~ ~~i~~In the rechargeable electronic watch 10 of the exemplary embodiments ~~concrete example according to the invention~~ shown in Fig. 2 to Fig. 5, supposing that power generation amount of the power generation means 1, namely, current generated by the power generation means 1 is IG, current consumption by driving the liquid crystal display means 22 is Ia, current consumption by driving the second display motor of the second display means 20 is Ib, current consumption by

driving the hour and minute display motor of the hour and minute display means 21 is Ic, and current consumption by oscillator, counter circuit or the like other than the respective display apparatuses in the watch circuit 5 is Iz, the operation mode control based on the energy balance corresponding to the magnitude of the power generation amount and the magnitude of the power consumption of the respective apparatus gives a relation as shown in Table 4.

In ~~the aforementioned~~ Table 4, if a system is ~~composed to permit~~designed to select the state marked with *1, the balance will not be negative even when the power generation is minimum (or null), but the time will be wrong.

In the exemplary embodiment~~concrete example according to the invention~~, it is also possible to ~~compose~~ design a rechargeable electronic watch operating with an energy source comprising a power supply including a power generation means and a power storage means charged with electric energy from the power generation means, the rechargeable electronic watch comprising a watch circuit for counting or operating hour information or function information or the like and outputting information, a display means for displaying hour information or function information or the like based on output signal from the watch circuit, a power storage amount detecting means for detecting the power storage amount flowing into ~~of~~ the power storage means, and a control means for controlling the operation of the watch circuit according to the energy balance of the power storage amount and the power consumption amount of the rechargeable electronic watch, wherein the watch circuit is driven by at least one clock operation mode selected from a plurality of clock operation modes different in power consumption provided by the watch circuit based on the control of the control means,

and moreover, it is also possible to design a rechargeable electronic watch operating with an energy source comprising a power supply including a power generation means and a power storage means charged with electric energy from the power generation means, the rechargeable electronic watch comprising a watch circuit for counting or operating hour information or function information or the like and outputting information, a display means for displaying hour information or function information or the like based on output signal from the watch circuit, a power generation amount detecting means for detecting the power generation amount of the power generation means, a remaining capacity detecting means for detecting the remaining capacity of the accumulation means and a control means for controlling the operation of the watch circuit according to the energy balance of the remaining capacity, the power generation amount and the power consumption amount of the clock, wherein the watch circuit is driven by at least one clock operation mode selected from a plurality of clock operation modes different in power consumption provided by the watch circuit based on the control of the control means.

Further, it is possible to compose a rechargeable electronic watch 10 operating with an energy source comprising a power supply including a power generation means and a power storage means charged with electric energy from the power generation means, the rechargeable electronic watch comprising a watch circuit for counting or operating hour information or function information or the like and outputting information, a display means for displaying hour information or function information or the like based on output signal from the watch circuit, a power storage amount detecting means for detecting the power storage amount flowing into ~~of~~ the power storage means, a

remaining capacity detecting means for detecting the remaining capacity of the accumulation means and a control means for controlling the operation of the watch circuit according to the energy balance of the remaining capacity, the power storage amount and the power consumption amount of the clock, wherein the watch circuit is driven by at least one clock operation mode selected from a plurality of clock operation modes different in power consumption provided by the watch circuit based on the control of the control means, and it is also possible to ~~compose to comprise~~use a power storage amount detecting means for detecting the power storage amount flowing to the accumulation means, a power storage amount detecting means for detecting the power storage amount into ~~of~~ the power storage means, and a control means for controlling the operation of the watch circuit according to the energy balance of the power generation amount, the power storage amount and the power consumption amount of the clock, wherein the watch circuit is driven by at least one clock operation mode selected from a plurality of clock operation modes different in power consumption provided by the watch circuit based on the control of the control means.

As mentioned above, the control means according to the present invention is preferably ~~composed~~ designed to control to drive in a predetermined clock operation mode among a plurality of clock operation modes different in power consumption so that the energy balance ~~would~~ is not ~~be~~ negative.

In other words, the clock operation mode is the one to stop at least a part of the display means, and the display means may be a hand, or the display means may be a digital display.

Briefly, the rechargeable electronic watch 10 according to the present invention is a

rechargeable electronic watch operating with an energy source comprising a power supply including a power generation means and a power storage means charged with electric energy from the power generation means, wherein the watch circuit is driven by at least one clock operation mode selected from a plurality of clock operation modes different in power consumption provided by the watch circuit based on the control of the control means.

In the exemplary embodiment ~~concrete example~~ of the present invention, the operation modes ~~in~~ provided by the user setting means by the user setting, namely the power saving means selected by the user setting are shown taking the relations shown in Table 3 as an example; however, ~~more concretely, cases~~alternative embodiments as shown below can be ~~supposed~~designed.

Namely, (1) not to inhibit display in any use state (user preference).

(2) Compel to display by pressing ~~the~~ a button or the like, when the liquid crystal display is inhibited, under ~~the~~ low power generation (for instance, when a rechargeable electronic watch driven by a solar cell is put in the dark).

(3) Set not to inhibit the alarm operation under any power generation amount.

(4) Inhibit to start the chronometric operation under ~~the~~ low power generation under, but not to inhibit the chronometric operation, once the same has started.

Concerning the setting of the user setting means in this exemplary embodiment~~concrete example~~, for instance,

1) regular setting (once set, valid until ~~the~~ cancellation)

2) temporary setting (valid only while the button is pressed)

states can be ~~supposed~~designed.

~~Besides~~Also, in the power generation amount detecting means 30 according to the present invention, for instance, the following cases can be ~~supposed~~ envisioned concerning the detecting timing of the power generation amount detecting means 30, power generation amount level judgment, respective mode transition control according to the power generation amount,

1) confirm the clock operation mode based on the actual power generation amount, if a state of a certain level of power generation has continued for a fixed period of time or more.

Such operation can limit the instant response to the power generation amount detecting, namely, inhibit an immediate transition to the power saving mode upon a momentary variation of power generation amount (for instance, when sunlight incident to a solar cell is shielded instantaneously by ~~the~~ a sleeve).

2) The power generation amount level is judged by ~~the~~ an integral value ~~for~~ over a fixed time.

Such operation can limit the instantaneous response to the power generation amount detecting for the same reason as 1), and increase the operation accuracy, in the balance judgment.

3) Sense the power generation amount intermittently.

Such operation reduces the current consumption of the power generation detecting itself.

4) Confirm the actual power generation amount, if a state in which the power generation amount sensed in ~~the~~ 3) is of certain level continuously equal or superior to a fixed number of times.

Such operation can limit the instantaneous response to the power generation amount

detecting, and consequently, inhibit an immediate transition to the power saving mode upon a momentary variation of power generation amount (for instance, when sunlight incident to a solar cell is shielded instantaneously by ~~the~~ a sleeve).

5) The transition between modes according to the power generation amount can be differentiated for the reducing power generation amount and for the increasing power generation amount. Namely, continuous detecting time or number of times required for level transition can be differentiated by the mode transition direction.

The feeling of ~~use of~~usage by the user can be improved, by making it difficult to transit to the mode in the direction to limit the function, and easier to transit to the mode in the direction to cancel the function limitation~~, through such operation~~. In other words, it becomes possible to not ~~to~~ limit the function ~~carelessly~~needlessly, and to cancel the function limitation promptly.

Another embodiment of the present invention is a driving method of a rechargeable electronic watch operating with an energy source comprising a power supply including a power generation means and a power storage means charged with electric energy from the power generation means, wherein the watch circuit is driven ~~by~~ in at least one clock operation mode selected from a plurality of clock operation modes different in power consumption provided by the watch circuit, according to the power storage amount of the power storage means.

Another exemplary embodiment ~~concrete example~~ of the present invention is a driving method of a rechargeable electronic watch operating with an energy source comprising a power supply including a power generation means and a power storage means charged with electric energy from the power generation means, wherein the watch

circuit is driven by at least one clock operation mode selected from a plurality of clock operation modes different in power consumption provided by the watch circuit, according to the remaining capacity detecting means for detecting the remaining capacity of the power storage means, ~~the remaining capacity~~ and the power generation amount of the power generation means.

Still another exemplary embodiment ~~concrete example~~ of the present invention is a driving method of a rechargeable electronic watch operating with an energy source comprising a power supply including a power generation means and a power storage means charged with electric energy from the power generation means, wherein the watch circuit is driven by at least one clock operation mode selected from a plurality of clock operation modes different in power consumption provided by the watch circuit, according to the remaining capacity detecting means for detecting the remaining capacity of the power storage means, ~~the remaining capacity~~ and the power storage amount into ~~of~~ the power storage means.

The rechargeable electronic watch and the driving method of the rechargeable electronic watch according to the present invention, adopting the technical ~~composition~~ approach mentioned above, is ~~composed~~ designed to optimize the electric power balance, by ~~composing to adopt to~~ selecting conveniently a clock operation mode according to the power generation amount of the power generation means and the power storage amount into ~~of~~ the power storage means, in an ordinary rechargeable electronic watch displaying hour information or a multi-function type rechargeable electronic watch ~~loaded~~ equipped with multiple functions providing many kinds of additional function information and, as ~~the~~ a result, it becomes possible to extend the clock operation duration of the

rechargeable electronic watch, and to provide a rechargeable electronic watch that would not adversely affect the feeling of ~~use~~ usage of the rechargeable electronic watch, by limiting the limitation of functions ~~user~~ by the user to a ~~the~~ strict minimum.

ABSTRACT OF THE DISCLOSURE

To extend the clock operation duration of a multi-functional rechargeable electronic watch, and to provide a rechargeable electronic watch that would not affect the feeling of use of said rechargeable electronic watch. A rechargeable electronic watch (10) operating with an energy source comprising a power supply (26) including a power generation means (1) and a power storage means (2) charged with electric energy from said power generation means (1), said rechargeable electronic watch comprising a watch circuit (5) for counting or operating hour information or function information or the like and outputting information, a display means (11) for displaying hour information or function information or the like based on output signal from said watch circuit, a power generation magnitude ~~volume~~ detecting means (3) for detecting the power generation volume of said power generation means (1), and a control means (5) for controlling the operation of said watch circuit (5) according to said power generation magnitude~~volume~~, wherein said watch circuit (5) is driven by at least one clock operation mode selected from a plurality of clock operation modes different in power consumption provided by said watch circuit (5).